

## ARGUMENTS/REMARKS

### Overview

Claims 1–32 remain in the application.

No new claims have been added.

No claims have been canceled.

Claims 1–8, 12–15, 19, and 24–29 remain unchanged in the application; they are neither amended nor canceled.

Claims 9–10 and 16–17 have been amended to correct informalities.

Claims 11, 18, 20–23, and 30–32 have been amended for greater clarity and to define the invention more particularly and distinctly.

Applicants assert that no new matter has been added by amendment.

### Claim Objections

Each of the claims 16 and 17 has been amended to depend from claim 11 to overcome the Examiner's informalities-based objections.

### 35 USC §103(a) Rejections

#### The amended claims 11 and 18 Are Patentable Over the Cited References

The rejection of claims 11 and 18, as being unpatentable over Barnsley<sup>1</sup> in view of Bristol<sup>2</sup> and Boothroyd<sup>3</sup>, is hereby traversed and reconsideration thereof is respectfully requested, in light of the reasons and remarks set forth below.

Each of the amended claims 11 and 18 recites, in pertinent part, applying one or more initialization codes to a chaotic system to cause the chaotic system to assume

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<sup>1</sup> U.S. Patent No. 4,941,193

<sup>2</sup> U.S. Patent No. 5,774,385

<sup>3</sup> David Boothroyd, *Chaos Systems: Electronic Applications Reap the Benefits*, New Electronics, v. 27, 25 October 1994, pp. 20–24.

one or more periodic orbits. The cited references, individually or in combination, do not suggest or teach the recited one or more initialization codes or uses thereof.

Bristol describes a method and apparatus for compressing a stream of data employing a first and a second pair of error boundary lines—the boundary lines adjusted so the received data samples are either on one of the first and second pair of error boundary lines or in an area between them—to generate best fit trend segments of the data stream. Bristol is silent on chaotic systems and fractal systems altogether. Accordingly, it fails to suggest or teach the initialization code(s), the periodic orbit(s), and the chaotic system (and/or uses of these) recited in each of the amended claims 11 and 18.

Boothroyd—reporting second hand on what he believes certain parties are doing in relation to fractal and/or chaotic systems and methods—does refer to periodic orbits. Interestingly, he does so in the section titled “Encrypting communications” (p. 23), and not in his treatment of subject matter related to image compression.

In particular, Boothroyd’s FIG. 2 (pp. 20–21) shows what appears to be a periodic orbit of a chaotic system. However, there is a multitude of ways to drive a chaotic system onto a periodic orbit. Nowhere does Boothroyd teach or suggest using an initialization code to cause a chaotic system to assume a periodic orbit, as is recited in the amended claims 11 and 18.

As described in the specification, an important advantage of the systems and methods of the claimed invention is the ability to drive a first chaotic system and a second chaotic system (the two systems having identical dynamics) onto the same periodic orbit by applying a select initialization code to each of the chaotic systems. For each periodic orbit, the systems and methods of the invention generate a periodic waveform having a particular harmonic structure which can be used to at least partially represent a portion of audio, image, video, or other data.

A family of one or more such initialization codes can be applied to a chaotic system to generate a family of one or more periodic waveforms in one-to-one correspondence with the initialization codes. The systems and methods of the claimed

invention then apply a family of one or more weights to the generated waveforms to approximate the portion the data.

Instead of conveying the data itself from the first to the second chaotic system, the systems and methods of the claimed invention convey the initialization codes and the weights (which together form a compressed representation of the data) from the first to the second chaotic system. The initialization codes then drive the second chaotic system onto the corresponding periodic orbits. The systems and methods of the invention then generate corresponding periodic waveforms to which the weights are applied to reproduce the data at a data decompressor. The recited initialization codes play a critical role in this data compression process.

Boothroyd fails to teach or suggest the recited initialization codes. Boothroyd also fails to teach or suggest applying weights to the periodic waveforms generated from the periodic orbits.

Barnsley teaches iterated system function codes (IFS codes). However, Barnsley's IFS codes are not the same as the initialization codes of the instant application; they are functionally distinct. There is no suggestion or teaching in Barnsley to indicate that the IFS codes can be applied to a chaotic system to cause the chaotic system to assume a periodic orbit.

Since, as admitted by the Office Action, Barnsley does not even teach periodic orbits, then Barnsley could not have taught the recited initialization codes needed to drive a chaotic system onto the periodic orbits.

In fact, not all codes applied to a chaotic system can serve as initialization codes. In particular, the instant specifications states (p. 17, lines 8–16):

[It] is possible to send an initialization code that drives the chaotic system onto a known periodic orbit. These special repeating codes lead to unique periodic orbits for all initial states, so that there is a one-to-one association between a repeating code and a periodic orbit. However, for some repeating codes, the periodic orbits themselves change as the initial

state of the chaotic system changes. Consequently, repeating codes can be divided into two classes, initializing codes and non-initializing codes.

Furthermore, the IFS codes of Barnsley are affine transformation coefficients that “completely represent” an input image (see Barnsley’s Abstract). In contrast, the initialization codes of the instant specification represent corresponding periodic orbits of the chaotic system and associated waveforms (see, for example, paragraphs 1–2 on p. 17 of the instant specification).

The Office Action suggests that there would have been motivation to combine Boothroyd and Barnsley to teach chaotic attractors having “almost periodic orbits.” However, Boothroyd’s reference to periodic orbits of chaotic systems is in the context of data encryption for secure communications, not data compression. Data encryption and data compression are distinct, substantially independent fields of art. A system that performs encryption, or a method of doing the same, cannot be used to perform data compression without undergoing nontrivial, and in many cases substantial, modification. A proposed combination in an obviousness rejection cannot require substantial reconstruction and redesign of the elements shown in a cited reference (MPEP 2143.01).

Furthermore, the Office Action admits that Barnsley is silent on periodic orbits. In fact, Barnsley provides no suggestion or motivation, either explicitly or implicitly, to incorporate periodic orbits into the fractal-based image compression system or method that produces or uses IFS codes. Nor does Boothroyd suggest or motivate, either explicitly or implicitly, combining periodic orbits of chaotic systems with the fractal-based image compression and decompression system and method of Barnsley, to perform data compression. Clearly, Boothroyd is aware of Barnsley’s image compression system and method. In fact, Boothroyd devotes his coverage of image compression solely to Barnsley (see Boothroyd’s section titled “Compressing images,” from col. 2, p21 to the middle of col. 1, p. 23); yet, Boothroyd fails to suggest or motivate combining periodic orbits (which he discusses in the section on “Encrypting communications”) with Barnsley’s fractal-based image compression system and method.

The amended claims 11 and 18 also recite, in pertinent part, generating a periodic waveform for a periodic orbit. The cited references fail to suggest or teach generating a periodic waveform for a periodic orbit. In this regard, the Examiner at least implicitly alleges that common knowledge exists of some kind of an equivalence between the recited generated waveform and the recited periodic orbit of the chaotic system. In particular, the Examiner states: "With the use of the word periodic orbit in the phase space representation of the chaotic attractor we can move to the more traditional use of the term waveforms in the time domain." (see the instant Office Action, p. 5, lines 11–13).

Applicant has disclosed generation of a periodic waveform for a chaotic system's periodic orbit in a previous U.S. patent application 09/437,565 (now U.S. patent 6,137,045), which is a parent in the priority chain of the instant application. Accordingly, Applicant traverses the Examiner's allegation and respectfully requests reconsideration of any rejection based thereon. Should the Examiner continue to maintain her rejection on the basis of the allegation, Applicant demands that the Examiner show documentary evidence for her statement by citing an authority supporting the allegation (MPEP 2144.03).

For at least the reasons that the cited references, individually or in combination, fail to suggest or teach the recited initialization code(s), periodic orbit(s), generated periodic waveform(s), and/or uses thereof, Applicant respectfully requests that the Examiner reconsider and withdraw the rejection of claims 11 and 18.

**Claims 1, 5, 8, and Amended Claims 20–21 Are Patentable Over the Cited References**

The rejection of claims 1, 5, and 8 and the amended claims 20 and 21, as being unpatentable over Barnsley in view of Bristol and Boothroyd, is hereby traversed and reconsideration thereof is respectfully requested, in light of the reasons and remarks set forth below.

Each of the claims 1, 5, 8, and the amended claims 20 and 21 recites, in pertinent part, initialization code(s), periodic orbit(s), generated periodic waveform(s),

and/or uses thereof. The arguments presented above in relation to the amended claims 11 and 18 also establish patentability for each of the claims 1, 5, 8, and the amended claims 20 and 21.

Moreover, each of the claims 1, 5, 8, and the amended claims 20–21, recites at least one additional limitation over the amended claims 11 and 18. In this section, and based on the at least one additional limitation, Applicant provides additional reasons supporting patentability of claims 1, 5, 8 and the amended claims 20–21 over the cited references.

Each of the claims 1, 5, 8, and the amended claims 20–21 recites, in pertinent part, use, approximation, or other processing or production of at least a portion of a slice of image data. Applicant has defined the term “slice” in the specification as follows (see paragraph 2, p. 3):

[T]he term slice denotes a single vertical or horizontal scan line on an analog screen or a single vertical or horizontal line of pixels in a digital image. For example, if the digital image is 1280x1024 pixels, there are 1280 rows, or slices, of 1024 pixels. Thus, the maximum slice length is externally imposed in an image application, and compression can be done on a slice of maximum length or on any portion thereof.

Barnsley does not suggest or teach image data processing (e.g., image compression) based on a slice of an image, or a portion of a slice—as defined in the instant specification. In fact, Barnsley teaches away from any data processing that is based on an image slice or a portion thereof (i.e., any data organized into a one-dimensional array), at least in part because he applies affine transformations to two-dimensional objects—such as a triangle, leaf, mountain, fern, chimney, or cloud, or even the space in which the object sits—in an image, whereas a “slice,” as recited in the claims and defined in the instant application, is inherently a one-dimensional array of data.

In particular, Barnsley finds smaller, distorted copies of the object. When fitted together and piled up, the distorted copies partially overlap and form a collage,

approximately adding up to the original, full object (e.g., the leaf). Barnsley produces and defines each distorted, shrunken copy by a particular affine transformation—a contractive map—of the whole object (e.g., leaf). For example, if it takes four miniature copies of the leaf to approximate the whole leaf, then there will be four such transformations (see Barnsley, col. 5, line 63 to col. 6, line 13). Barnsley's system and method described above cannot be applied to a one-dimensional array of data, such as the image, or a portion thereof, as recited in the claims.

Moreover, Barnsley's affine transformations are at least two-dimensional. In particular, Barnsley defines an affine transformation  $W: K \rightarrow K$  to be a continuous mapping, where  $K$  denotes one of the spaces  $R^n$ , where  $n=2, 3$ , or  $4$  (see col. 13, lines 14–15). For image data processing, Barnsley discloses the following two-dimensional mapping, which cannot be applied to a one-dimensional array of data such as a slice of image data or a portion thereof (col. 13, line 20, Equation 1):

$$W \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} e \\ f \end{pmatrix}$$

Combining Barnsley with another reference that may teach slice-based (or any one-dimensional) image data processing would render Barnsley inoperable for its intended purpose. Therefore, Barnsley cannot even be combined with any other such reference (MPEP 2143.01).

Accordingly, the cited references fail to suggest or teach the use, approximation, or other processing or production of at least a portion of an image slice, and hence they fail to suggest or teach part of the subject matter recited in each of claims 1, 5, 8 and the amended claims 20–21.

**Independent Amended Claim 22 is Patentable Over the Cited References:**

The rejection of the amended claim 22, as being unpatentable over Barnsley in view of Bristol and Boothroyd, is hereby traversed and reconsideration thereof is respectfully requested, in light of the reasons and remarks set forth below.

The amended claim 22 is patentable over the cited references for at least the reasons set forth above, in relation to the amended claims 11 and 18. Moreover, the amended claim 22 recites, in pertinent part, the additional limitations of identifying a correlation between data in a first portion of the data signal and data in at least one other portion of the data signal, and including the correlation information in the compressed representation of the image.

The cited references, individually or in combination, do not teach the additional limitations of the amended claim 22. Accordingly, Applicant requests that the Examiner withdraw the rejection.

**Amended Claims 23 and 30–32 Are Patentable Over the Cited References:**

The rejection of the amended claims 23 and 30–32, as being unpatentable over Barnsley in view of Bristol and Boothroyd, is hereby traversed and reconsideration thereof is respectfully requested, in light of the reasons and remarks set forth below.

These claims are generally directed to systems and methods for decompressing compressed data produced using a first chaotic system. In particular, the amended claims 23 and 30–32 recite, in pertinent part, causing a second chaotic system, substantially identical to the first chaotic system, to assume one or more periodic orbits by applying one or more initialization codes to the second chaotic system. Moreover, the claims recite generating one or more periodic waveforms for the one or more periodic orbits. As argued above in relation to the amended claims 11 and 18, the cited references, individually or in combination, fail to suggest or teach the initialization code(s), the periodic waveform(s), and/or uses thereof.

The amended claim 30 recites, in pertinent part, the further limitation of producing a second slice of image data substantially identical to a first slice of image data by decompressing a compressed representation of the first slice of image data. As argued above in relation to the claims 1, 5, 8 and the amended claims 20–21, Barnsley cannot be used for—nor can it be combined with any reference to suggest or teach—slice-based processing of data. Therefore, the cited references fail to suggest or teach this additional limitation recited in the amended claim 30.

The amended claim 32 recites, in pertinent part, the limitation of applying correlation information to a first portion of a second data signal to produce a second portion of the second data signal. As argued in relation to the amended claim 22, the cited references do not suggest or teach this additional limitation.

Accordingly, Applicant requests that the Examiner withdraw the rejection of each of the amended claims 23 and 30–32.

**Dependent Claims 2–4, 6–7, 9–10, 12–17, 19, and 24–29 Are Patentable Over the Cited References:**

As claims 2–4, 6–7, 9–10, 12–17, 19, and 24–29 variously depend from claims 1, 5, 8, 11, 18, and 23 and recite further limitations thereon, they are a fortiori patentable over the cited references.

Additionally, for claim 3, the Examiner has asserted that Barnsley teaches the step of identifying trends. The Examiner states: “Barnsley teaches the use of polynomial (function) to approximate recurring image elements in image compression (column 21, lines 34–36).” (see p. 6, item c(i)(1) of the instant Office Action).

To the contrary, nowhere does Barnsley suggest or teach using a “polynomial (function)” approximation to data, or identifying a trend in the data. Rather, the segment in Barnsley cited by the Examiner is directed to a “*polygonal* approximation” (not a *polynomial* approximation), and the approximation is that of the boundary of an object (e.g., a leaf) in the image (see col. 21, lines 34–36), not image data values (e.g., pixel intensity and/or color values). This is further corroborated by Boothroyd, who states: “The fractal technique looks for shapes and patterns within an image and stores these as concise mathematical formulae.” (see Boothroyd, p. 21, col. 1, last sentence of par. 2).

Additionally, there is no indication in Barnsley that the polygonal approximation is performed on the *compressed* image (as is recited in claim 3).

Furthermore, according to the Merriam-Webster Online Dictionary, “trend” is defined as (1) a line of general direction or movement; (2)(a) a prevailing tendency or

inclination; (2)(b) a general movement; (2)(c) a current style or preference; (2)(d) a line of development; (3) the general movement in the course of time of a statistically detectable change; *also* : a statistical curve reflecting such a change.

What the Examiner has cited in Barnsley is directed to approximating the pattern or shape of an object in the image (e.g., the contour of a leaf), not a trend in the image data (e.g., a trend in pixel intensity and/or color values along a slice of an image). Therefore, Barnsley does not suggest or teach the limitations recited in claims 3, 13, and 14.

Moreover, claim 13 recites, in pertinent part, removing an identified trend from at least a portion of the data signal. Although Bristol teaches identifying a trend for a data stream, he does not teach subtracting the trend from the data stream. Barnsley and Boothroyd fail to remedy the deficiency of Bristol. Accordingly, the cited references, individually or in combination, fail to suggest or teach the removal of the trend from the data, as is recited in claim 13.

In light of the remarks and arguments set forth above, Applicant respectfully requests that the Examiner reconsider and withdraw the rejection of all the dependent claims.

## CONCLUSION

In view of the above remarks, Applicant submits that claims 1–32 are in condition for allowance, and requests that the Examiner pass this application to allowance.

If the Examiner believes that a telephone conversation with Applicant's attorney would expedite allowance of this application, the Examiner is invited to call the undersigned.

Applicant believes no fee is due with this response other than as reflected on the enclosed Fee Transmittal. However, if a fee is due, please charge our Deposit Account No. 18-1945, under Order No. UON-P01-004 from which the undersigned is authorized to draw.

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